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CALIFORNIA INSTRUMENTS
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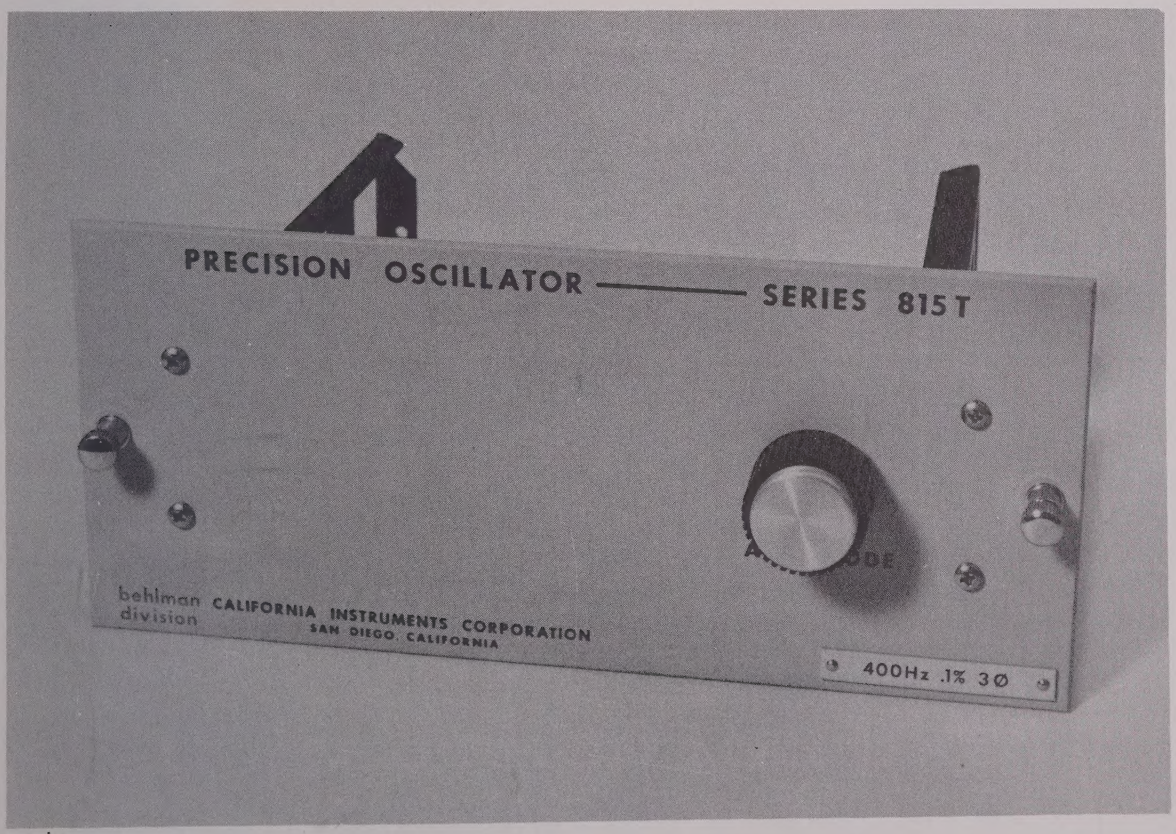
Revision D
August, 1975

INSTRUCTION MANUAL

SERIES 815T
815T-400-.1-1
PRECISION

OSCILLATOR



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ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
None	4815-400	UNIT ASSEMBLY
	4815-070	INTERCONNECTING DIAGRAM
A1	4815-700	BASIC OSCILLATOR ASSEMBLY
	4815-071	BASIC OSCILLATOR SCHEMATIC
A2	4800-701	SINGLE PHASE TO MULTIPHASE CONVERTER ASSEMBLY
	4800-072	SINGLE PHASE TO MULTIPHASE CONVERTER SCHEMATIC

MANUAL ADDENDUM
MODEL 815T-400-0.1-1

The Model 815T-400-0.1-1 provides a single phase 400 Hz ±0.1% output to drive a California Instruments Solid State Invertron®.

See the frequency determining parts list for component values which change with operating frequency.

CALICO | CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	REF. DRAWING	4815-700-1 and 4815-071 -	400 Hz		1
					2
1C1	PD1A 473 +0% -1%	CAPACITOR .047 µf +0% -1%	12406	6-10552	3
1C2	6MPD-1-622J	CAPACITOR .0062/600V 5%	04062	6-10545	4
1C3	6MPD-1-622J	CAPACITOR .0062/600V 5%	04062	6-10545	5
1C4	PD1A 473 +0% -1%	CAPACITOR .047 µf +0% -1%	12406	6-10552	6
1C9	TE 1148	CAPACITOR 1 µf/15V	56289	6-10151	7
					8
					9
					10
1R1	RN60C7321F	RESISTOR 7.32K 1/8W 1%	81349	5-60243	11
1R2	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	12
1R5	RN60C7321F	RESISTOR 7.32K 1/8W 1%	81349	5-60243	13
1R10	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	14
					15
					16
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EL 815T | CALICO P/N 4815-700 | ASSY R.O. 1ø 2ø 3ø

-E FREQUENCY DETERMINING PARTS LIST | SHT 7 OF | 400Hz

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SPECIFICATIONS

All specifications are tested in accordance with standard California Instruments test procedures. All specifications apply over the frequency range from 45Hz to 10Hz. Consult the manual addendum for the actual oscillator output frequency.

MODEL NUMBER:	815T-Freq-.1-1	815T-Freq-.1-3*	815T-Freq-.1-2
No. of Phases:	single phase	three phase	two phase
Nominal Phase Shift:	Not applicable	120 degrees	90 degrees
Phase Sequence:	Not applicable	ABC sequence	CA sequence
Amplitude Tracking: (with amplitude potentiometer adjusted from 75% of full output to full output)**	Not applicable	1.0 per cent of full scale	1.0 per cent of full scale
Phase Accuracy at 25°C: (with amplitude potentiometer adjusted from 75% of full output to full output)**	Not applicable	±1.0 degree maximum.	±1.0 degree maximum.

SPECIFICATIONS COMMON TO ALL MODELS

Frequency:	Single Fixed Frequency, 45Hz to 10KHz.
Frequency Accuracy at 25°C:	±0.10 percent.
Frequency Temperature Coefficient:	±.02 percent/°C maximum
Output Amplitude:	5.0 volts rms maximum for single phase versions; 0 to greater than 5 volts rms for multiphase versions.
Amplitude Stability: (after one hour warm-up)	±0.25 percent for 24 hours at 25°C ±0.02 percent/°C maximum
Total Harmonic Distortion:	0.2 percent maximum

Input Power:	±25 volts DC at approximately 18 milliamperes available from power source for single phase versions: ±25 volts DC at approximately 55 milliamperes available from power source for three phase versions.
Operating Temperature Range:	0 to 55°C for all versions.
Dimensions:	3-1/2" high x 8" wide x 7" deep for mounting into a California Instruments Solid State Invertron®.
Front Panel Finish:	Grey 26440. Federal Standard 595.

* Order Model 815T-Freq-.1-3D for use in the three phase open delta configuration.

** This is a new improved specification. Oscillators manufactured prior to October 1974 (-4 run) were specified at 2% amplitude tracking with the AMPLITUDE control fully clockwise and 2° phase error with the AMPLITUDE control fully clockwise.

These early oscillators were not specified as to additional phase and amplitude tracking errors when the AMPLITUDE control was turned counter-clockwise from the fully clockwise position.

Step 5.6.4 was added to this manual at the "D" Revision to test for these improved characteristics in oscillators manufactured after October, 1974.

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the California Instruments 815T Series Precision Oscillators. A detailed theory of operation is provided as an aid to maintenance personnel. A complete parts listing, schematics and component location drawings are also supplied.

1.2 MODEL NUMBER DESCRIPTION

All oscillators in the 815T Series have a four or five place model number which describes the following features: the oscillator series, the output frequency of the oscillator, the frequency tolerance of the oscillator, and the number of phases of the oscillator. In addition, a "D" is placed after the model number if the oscillator is to be used in the three phase, open delta configuration. The following examples illustrate this numbering system.

Example 1: 815T-400-0.1-3ϕ

This is a 400 Hz, three phase oscillator with a specified frequency accuracy ±0.1%

Example 2: 815T-50-0.1-3ϕD

This is a 50 Hz, three phase oscillator for use in the open delta configuration with a specified frequency accuracy of ±0.1%

1.3 GENERAL DESCRIPTION

The California Instruments 815T Series Oscillators provide a pure sine wave output for driving the California Instruments Solid State Invertrons.® This oscillator incorporates a unique F.E.T. amplitude regulator circuit.

The multi-phase versions of the 815T Series Oscillators are used to drive two or more Solid State Invertrons® connected so as to provide either two phase or three phase power.

1.4 ACCESSORY EQUIPMENT

The following equipment is available for use with the 815T Series Oscillators.

1.4.1 4800-703 Extender Assembly. This assembly allows the oscillator to be tested and adjusted outside of the associated Solid State Invertron®.

CAUTION

HIGH VOLTAGE

Voltages up to 500 VAC are available in certain associated Invertrons®. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with connector pins C and D of the plug in oscillator, the primary power circuits, and output circuits of the associated Invertron® if oscillator is tested and adjusted with Invertron®.

INSTALLATION AND OPERATION

2.1 UNPACKING

Individual oscillators are shipped in a cardboard container with protective inner packing. Do not destroy this packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

Single phase versions of the California Instruments 815T Oscillator operate from plus (+) and minus (-) 25 volts DC at 0.018 amperes. This power is normally obtained from the associated Invertron.® Three phase versions of the 815T Oscillator require approximately 55 milliamperes at ± 25 volts D.C.

2.3 FUSE REQUIREMENTS

No separate fuse is required with the California Instruments 815T Series Precision Oscillators.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following:

Mount the oscillator in the appropriate rack housing or otherwise apply ± 25 volt DC power to the unit.

2.4.1 MODEL 815T-Freq-Tol-1ϕ FIXED FREQUENCY OSCILLATOR

Figure 5-1 shows a test circuit for the 815T Series Oscillators. The output of this single phase oscillator should be 5.0 volts rms minimum. Connect an oscilloscope to the output of the oscillator and check that the oscillator has a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if futher evaluation of the oscillator is required at this time.

2.4.2 MODEL 815T-Freq-Tol-3ϕ FIXED FREQUENCY OSCILLATOR

The output of this three phase oscillator is controlled by the front panel AMPLITUDE control. Rotate this control fully clockwise. The output amplitude of each phase of the oscillator should be at least 5 volts rms. See Figure 5-1 for a detailed test circuit.

Connect an oscilloscope to the output of the oscillator and check that each phase of the oscillator has a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if further evaluation of the oscillator is required at this time.

2.4.3 MODEL 815T-Freq-Tol-2ϕ FIXED FREQUENCY OSCILLATOR

The output of this two phase oscillator is controlled by the front panel AMPLITUDE control. Rotate this control fully clockwise. The output amplitude of each phase of the oscillator should be at least 5 volts rms. See Figure 5-1 for a detailed test circuit.

Connect the oscilloscope to the output of the oscillator and check that both phases of the oscillator have a clean sine wave output with no clipping or other distortion. Check that the output frequency is within 0.1 per cent of that indicated in the manual addendum. Detailed test procedures are given in the TEST PROCEDURE of this manual if further evaluation of the oscillator is required at this time.

2.5 MECHANICAL INSTALLATION AND WIRING

The 815T Series Precision Oscillators fit directly into the California Instruments Solid State Invertron® Series of power amplifiers. All power for the oscillator, as well as signal output is coupled through the printed circuit connector at the rear of the oscillator. The following table lists the voltage and applicable connector pins.

Pin	Function	
1	Output signal low	Phase A
2	Output signal high	Phase A
3	Power Ground	
4	+25 volt input	
5	-25 volt input	
6	Output signal low	Phase B
7	Output signal high	Phase B
8	Output signal low	Phase C
9	Output signal high	Phase C
10	External sync input	
C	115 volts AC line high	
D	115 volts AC line low	

The single phase version of the 815T Series Oscillator only has an "A" phase output. The two phase version of the 815T Series Oscillator has an "A" and "C" phase output while the three phase version of this oscillator has all three outputs. The external sync input and 115 volt AC inputs are not used for the standard versions of this oscillator.

2.6 OPERATING CONTROLS

Single phase versions of the 815T oscillator have no front panel operating controls. Multiphase versions of this oscillator have an AMPLITUDE control which is used to vary the output voltage level of all phases of the oscillator from 0 volts to greater than 5.0 volts rms.

In a multiphase power source, the GAIN control on each of the associated power amplifiers is used as a trim control to adjust each of the output leg voltages so that they are precisely equal to each other.

CAUTION

REMOVE POWER FROM
CALIFORNIA INSTRUMENTS
SOLID STATE INVERTRON®
BEFORE REMOVING OR
INSERTING PLUG-IN
OSCILLATOR

1 DESCRIPTION OF SINGLE PHASE OSCILLATOR

A block diagram for the basic single phase oscillator in the 815T Series is given in Figure 3-1. A schematic diagram for the oscillator printed circuit board (designated as the A1 Assembly) is given in drawing D4815-071. An inner connecting wiring diagram is given in drawing D4815-070 for single phase, two phase and three phase versions of this oscillator.

The frequency determining elements are arranged in a Wien bridge configuration which is connected as a positive feedback loop around an operational amplifier as illustrated in Figure 3-1. The frequency of oscillation f_o is given by the equation,

$$f_o = \frac{1}{2\pi RC}$$

where R is the total resistance in the positive feedback path and C is the total capacitance in the positive feedback path. At the frequency of oscillation f_o, the positive feedback loop has a transmission of 0.333 and a zero phase shift. The negative feedback loop must adjust the closed loop gain of the operational amplifier A1IC1 to exactly 3.00 in order for the Wien bridge oscillator to produce a pure sine wave output with a minimum of distortion. This is accomplished by means of a servo feedback loop consisting of the level detector, a DC amplifier and the amplitude regulator. Whenever there is a change in the amplitude of the oscillator, a correction signal appears at the output of the level detector circuit. This correction signal is amplified by the DC amplifier and applied to control the output impedance of the amplitude regulator. The output impedance of the amplitude regulator controls the closed loop gain of the operational amplifier A1IC1. Therefore, any variation in the output of the oscillator is corrected by this servo feedback. The detailed circuit description is given in Section 3.1.1.

1.1 DETAILED CIRCUIT OPERATION

A schematic diagram for the single phase oscillator is shown in drawing D4815-071. All components of this oscillator are mounted on circuit board 4815-700, designated as the A1 assembly.

1.1.1 LEVEL DETECTOR

The level detector consists of A1R13, A1R14, diodes A1CR3, A1CR4, A1CR1, A1CR2, transistor A1Q3 and capacitor A1C9. The series connected reference elements diodes A1CR3, A1CR4 and base-emitter diode of A1Q3 act so as to set the level of the oscillator output. Diode A1CR3 and A1CR4 conduct on the positive peak of the sine wave output and inject a current pulse into the emitter of A1Q3. The average value of this current pulse is approximately 1.6 microamperes DC when the oscillator has a 5.5 volt rms output at A1 pin 15.

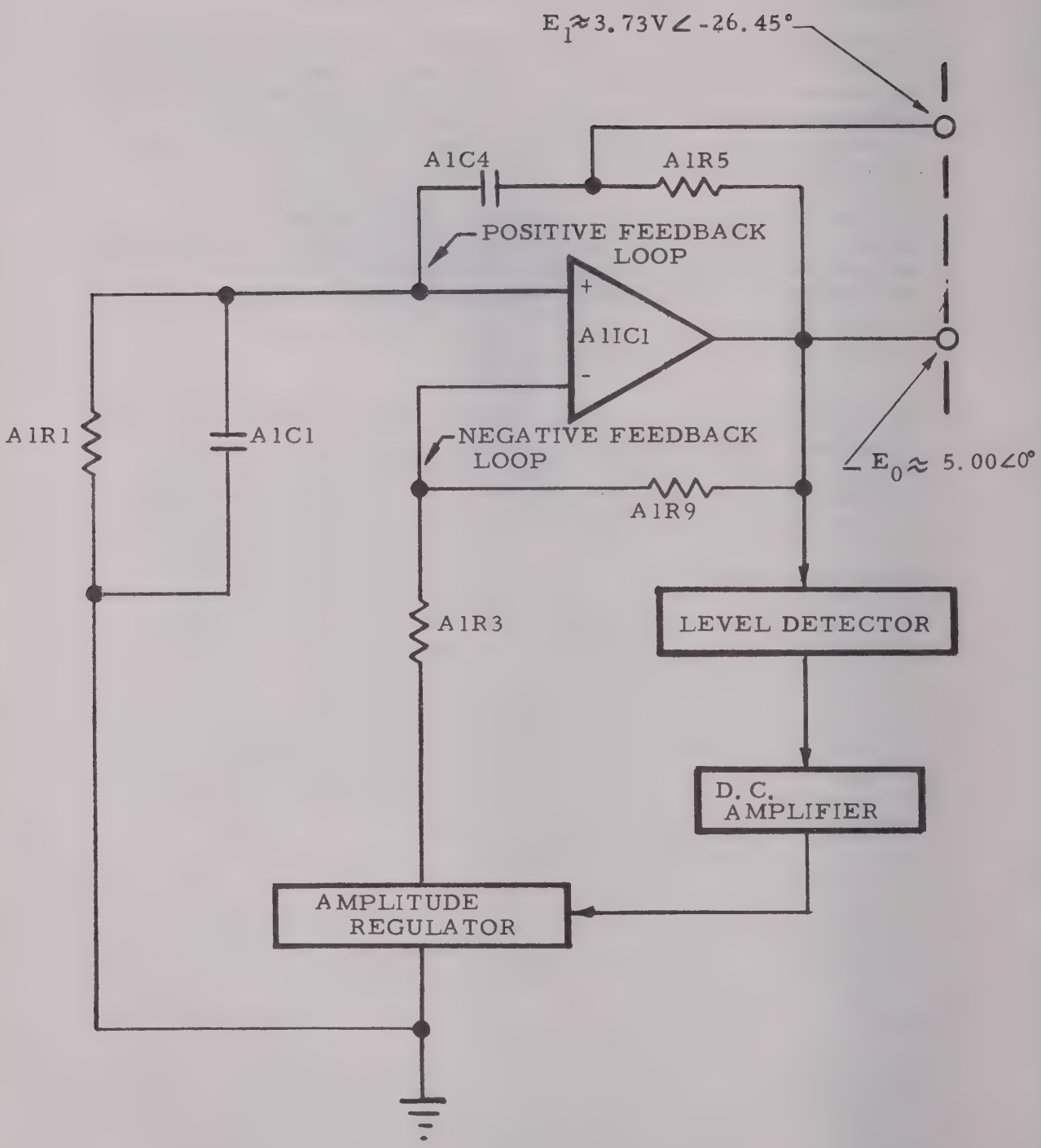


FIGURE 3-1. Block diagram of basic Wien Bridge Oscillator employed in 815T Series Oscillator.

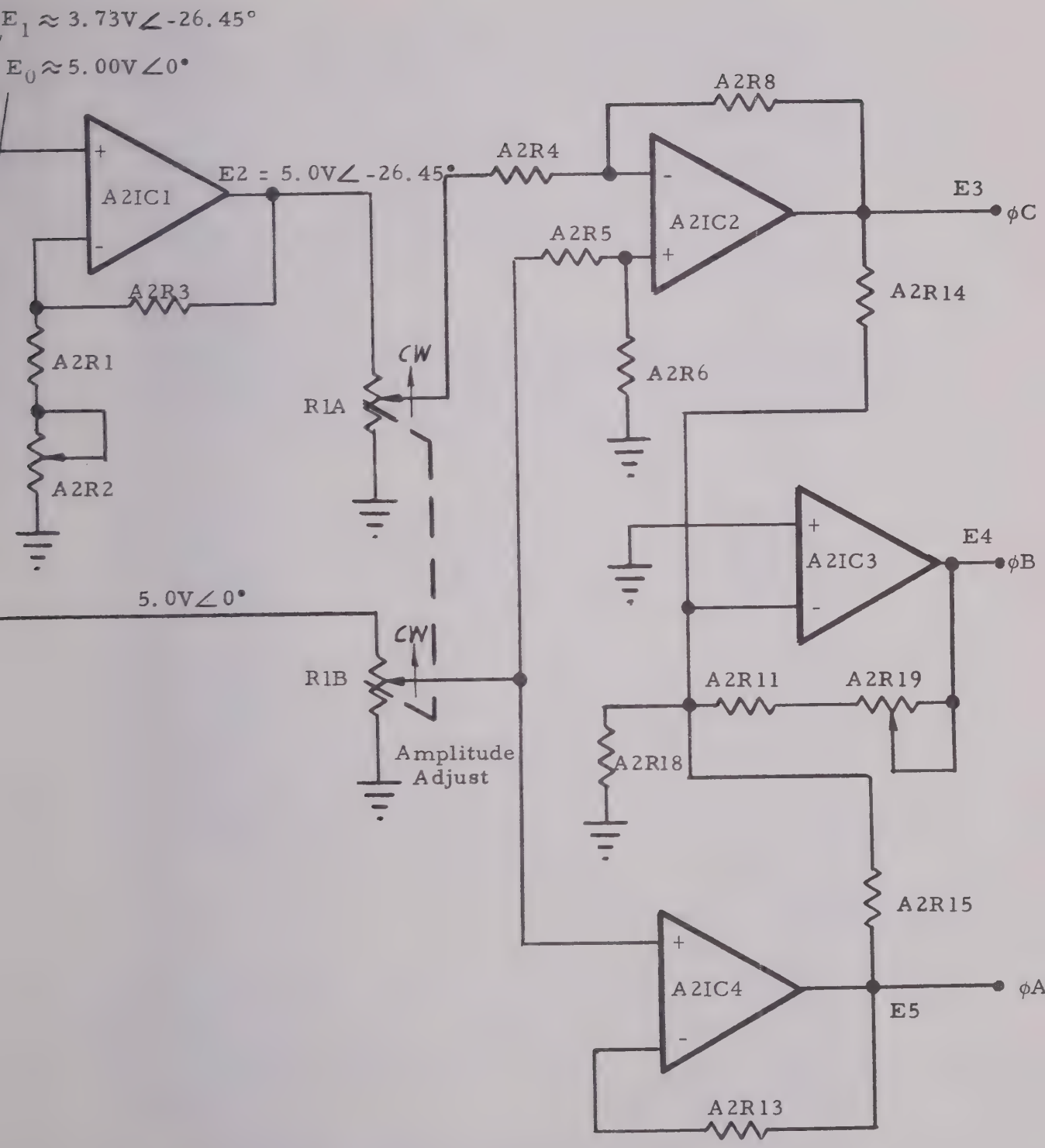


FIGURE 3-2. Block Diagram of Single to Multiphase Converter employed in 815T Series Oscillator.

This current pulse appears in the collector circuit of A1Q3 where it is filtered by capacitor A1C9 to form a DC level across the load circuit, A1R13 in series with A1CR1 and A1CR2. Any variation in the amplitude of the oscillator output will produce a change in the voltage drop across A1C9.

The level detector circuit is temperature compensated by selecting a zener diode A1CR4 with a positive temperature coefficient so as to cancel the negative temperature coefficients of diode A1CR3 and the emitter-base junction of transistor A1Q3.

3.1.1.2 DC AMPLIFIER

Transistor A1Q2 and associated components are connected so as to form a DC amplifier with a small signal gain of approximately five. The signal across A1C9 is amplified and level-shifted for application to the gate of A1Q1.

3.1.1.3 AMPLITUDE REGULATOR

Field effect transistor A1Q1 is connected so as to form an amplitude regulator. The bias at the gate of A1Q1 controls the output impedance (channel resistance) of the amplitude regulator. This output impedance, in turn, controls the closed loop gain of the operational amplifier, A1IC1.

If the sine wave output of the Wien bridge oscillator increases for any reason, the voltage drop across A1C9 also increases, which provides additional base drive to A1Q2. This causes the collector current of A1Q2 to increase and to cause the gate of A1Q1 to be biased more negatively. When the gate of A1Q1 is driven more negatively, the channel resistance of A1Q1 increases. This increase in channel resistance causes the closed loop gain of the operational amplifier A1IC1 to decrease, which in turn decreases the output amplitude of the Wien bridge oscillator and returns it to its original value.

3.2.1 POWER SUPPLY REGULATORS

The power supply regulators allow the oscillator to operate from the unregulated ± 25 volt DC power supply in all California Instruments solid state Invertron® power sources. The oscillator requires ±18 to ± 55 milliamperes with less than 2 volts of peak-to-peak ripple at the input to the regulator. The output of the regulators is ±15 volts ±10 per cent with less than 150 millivolts peak-to-peak ripple.

3.2 GENERAL DESCRIPTION OF SINGLE PHASE TO MULTI-PHASE CONVERTER

A block diagram for the single phase to multi-phase converter is given in Figure 3-2. This circuit employs an analog computer technique of generating the second and third phases of the multi-phase

output. This technique requires no additional tuned circuits and provides the required phase shift independent of oscillator frequency.

The operation of this circuit is dependent on the signal E1 which is available at the junction of the resistive and capacitive elements in the positive feedback loop of the Wien bridge oscillator. A detailed analysis of the basic Wien bridge circuit configuration reveals that the voltage E1 at the frequency of the oscillation f_o is given by:

$$E1 = 0.746\ E0 \angle -26.45°$$

The above equation is valid regardless of the frequency of oscillation. Therefore, it is not necessary to vary these circuit parameters as the frequency oscillator is shifted.

The voltages, E0 and E1, are then processed through a sequence of operational amplifiers to provide the phase "A", phase "B" and phase "C" outputs. The vector diagram below describes how this is accomplished in graphical terms with the AMPLITUDE potentiometer R2 in the fully clockwise position.

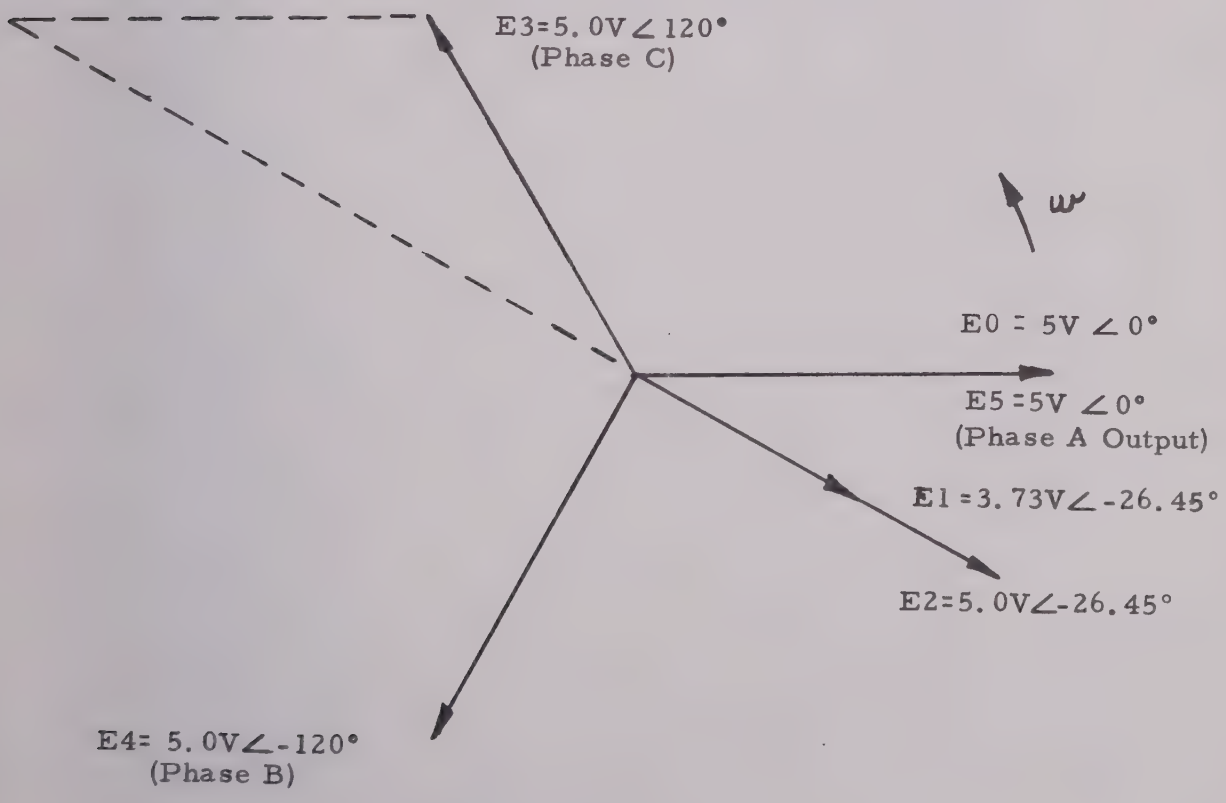


FIGURE 3-3. Vector Diagram for Generation of three-phase Output

First E1 is amplified by a factor of 1.34 to generate E2 at the output of A2IC1. Then E2 is inverted and amplified by a factor of -1.94 by means of the inverting input to A2IC2. The output of the Wien bridge is amplified by a factor of 1.24 with the non-inverting input to A2IC2. The resultant output from A2IC2 provides an E3 (or phase "C") output.

Then E0 is processed through a voltage follower to provide an E5 (or phase "A") output at the output of A2IC4.

Finally, E3 and E5 are added algebraically and then inverted to provide an E4 (or phase "B") output at the output of A2IC3.

For two phase operation, the gain of A2IC2, referenced to the E2 and E0 signals, is changed to -2.245 and 2.01 respectively. This provides a 90 degree phase lead for the phase "C" signal when referenced to the phase "A" signal. The phase "B" signal is not used in this application of the oscillator. For three phase open delta operation, the gain of A2IC2, referenced to the E2 and E0 signals, is changed to -1.94 and 2.24 respectively. This provides a 60 degree phase lead for the phase "C" signal when referenced to the phase "A" signal. The phase "B" signal is not used in this application of the oscillator.

CAUTION

HIGH VOLTAGE (115 AC)

Voltages up to 500VAC are available in certain associated Invertrons®. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with connector pins C and D of the plug in oscillator, the primary power circuits, and output circuits of the associated Inventron® if oscillator is tested and adjusted with Invertron®.

ADJUSTMENT PROCEDURE

4.1 GENERAL

The following adjustment procedure, or any part of it, may be performed on a routine basis to insure that the oscillator remains within the specified performance limits. This procedure should always be followed after any service to the basic oscillator circuitry.

The adjustment procedure is divided into two sections. These are:

1) Adjustment procedure for Wien bridge oscillator.
2) Phase adjustments for single phase to multiphase converter.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the adjustment procedure.

a) Oscilloscope, Tektronix 531A with general purpose plug-in or equivalent.

b) California Instruments Power Source or two H.P. 721A DC Power Supplies or equivalent.

c) Distortion Analyzer, H.P. H02-330B or equivalent.

d) Differential Voltmeter, Fluke 883A or equivalent.

e) Frequency Meter, H.P. 523CR or equivalent.

f) Differential phase meter, DRANETZ 301 or equivalent.

4.3 ADJUSTMENT PROCEDURE FOR WIEN BRIDGE OSCILLATOR

Connect the precision oscillator as shown in Figure 5-1 using either the ±25 volt power supply in the California Instruments Solid State Invertron® or a pair of external +25 volt and -25 volt DC power supplies. Each power supply should draw from 18 to 55 milliamperes. Allow the unit to warm up for one half hour.

4.3.1 Starting with potentiometers A1R2, A1R4 and A1R10, in a fully counter clock wise position, rotate A1R4 slowly in the clockwise direction until the oscillator output just builds up to full output. Rotating A1R4 too far clockwise will cause excessive distortion in the output wave form.

4.3.2 After determining the basic frequency and frequency accuracy of the oscillator from the manual addendum, set the basic Wien bridge oscillator frequency by rotating A1R2 and A1R10 equal amounts in the clockwise direction. The frequency may be monitored with the counter at the integrated circuit A1IC1 pin 6 or at the phase "A" output. The potentiometers A1R2 and A1R10 have sufficient resolution to allow the frequency to be set within 0.05 per cent.

4.3.3 Measure the output amplitude and distortion of the Wien bridge oscillator at the phase "A" output with the differential voltmeter and distortion analyzer. The output amplitude should be between 5 volts and 6 volts rms. The distortion should be less than 0.2 percent. If the phase "A" distortion is excessive, or if the oscillator will not start in a reliable fashion when DC power is applied to the oscillator, perform step 4.3.4 below.

4.3.4 Rotate A1R4 counter clockwise until the output amplitude drops by 1 to 5 percent. Then rotate A1R2 and A1R10 slightly in opposite directions until a peak in the output amplitude is obtained while maintaining the correct output frequency. Reset A1R4 so that the oscillator starts in a reliable fashion when DC power is applied to the oscillator and that the distortion is less than 0.2 per cent.

4.4 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-2ϕ TWO PHASE OSCILLATOR

4.4.1 Connect the Model 815T-Freq-Tol-2ϕ Oscillator as shown in Figure 5-1 using either the ± 25 volt DC supplies in the California Instruments Invertron® or a pair of external ±25volt DC power supplies. Check that the procedure given in Section 4.3.1 through 4.3.4 of this instruction manual has been performed before proceeding further.

4.4.2 Rotate the front panel AMPLITUDE control fully clockwise. Connect a differential phase meter from the junction of A1R11 and A1R14 to the junction of A2R17 and A2R3. The phase shift must be -26.45 degrees ±0.25 degrees. Parameter unbalance in the basic Wien bridge feedback circuit can cause errors in this phase shift.

4.4.3 Adjust potentiometer A2R2 so that the amplitude of the AC voltage at the junction of A2R3 and A2R17 is equal to the voltage measured at the junction of A1R11 and A1R14.

4.4.4 Monitor the phase "A" output of the oscillator with the differential voltmeter and record the AC output voltage.

4.4.5 Monitor the phase "C" output of the oscillator with the differential voltmeter and record the AC output voltage. The amplitude of the phase "A" and phase "C" output voltages should now correspond within 50 millivolts rms of one another.

4.4.6 Connect the differential phase meter from the phase "A" output to the phase "C" output. Readjust potentiometer A2R2 slightly so that the phase "C" output leads the phase "A" output by 90 degrees ±1 degree and that the amplitude of the phase "A" and phase "C" outputs are within 10 millivolts rms of one another.

4.4.7 Capacitors A2C9 and A2C11 have been installed in the factory for improved phase shift characteristics on certain high-frequency versions of the 815T Series Oscillator.

4.5 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-3ϕD THREE PHASE, OPEN DELTA OSCILLAOR

4.5.1 Connect the 815T-Freq-Tol-3ϕD oscillator as shown in Figure 5-1 and repeat step 4.4.1 through 4.4.7, except check that the phase shift is 60 degrees ±1 degree.

4.6 PHASE ADJUSTMENTS FOR MODEL 815T-Freq-Tol-3ϕ THREE PHASE OSCILLATOR

4.6.1 Connect the 815T-Freq-Tol-3ϕ oscillator as shown in Figure 5-1 and repeat steps 4.4.1 through 4.4.7, except check that the phase shift is 120 degrees ±1 degree.

4.6.2 Adjust A2R19 so that the phase "B" output amplitude is equal to the phase "A" output amplitude within 10 millivolts rms.

4.6.3 Check that the phase shift of phase "B" referenced to phase "A" is -120 degrees ±1 degree. Capacitor A2C10 (10 pf or less) has been selected at the factory for the best compromise phase shift and amplitude tracking on certain high-frequency versions of this oscillator.

TEST PROCEDURE

5.1 GENERAL

The following test procedure may be performed on a routine basis to insure that the 815T Series Oscillator remains within the specified performance limits. This test procedure is divided into several sections. These are:

1) Output voltage and amplitude stability

2) Harmonic distortion

3) Output frequency and frequency stability

4) Phase accuracy

5.2 TEST EQUIPMENT REQUIRED

The same test equipment is required for the test procedure as was required for the adjustment procedure as given in Section 4.2 of this manual.

5.3 OUTPUT VOLTAGE AND AMPLITUDE STABILITY

5.3.1 Connect the variable frequency oscillator as shown in Figure 5-1 and allow the unit to warm up for one hour in a 25°C environment. In the case of a multiphase oscillator, rotate the AMPLITUDE control fully clockwise.

5.3.2 The output of the oscillator should be measured with differential voltmeter connected to the phase "A" output (Pin 1 and Pin 2 of the printed circuit connector). The output voltage should be between 5.0 volts rms and 6.0 volts rms. Record the exact value of the output voltage.

5.3.3 Measure the phase "A" output voltage in 15 minute increments for two hours. The change in output voltage must not exceed ± 12.5 millivolts rms. This test may be continued for 24 hours if required. Maintain the ambient temperature at 25°C for this test.

5.3.4 Increase the ambient temperature to 50°C and allow the unit to stabilize for one hour. The output should change less than ±25 millivolts rms.

5.4 HARMONIC DISTORTION

Connect the precision oscillator as shown in Figure 5-1 and allow the unit to warm up for a few minutes. In the case of the multiphase oscillators, turn the AMPLITUDE control so that the output from each phase is approximately 5.0 volts rms.

5.4.1 Connect the distortion analyzer between the high output of phase "A" and the ground of phase "A". The distortion should be less than 0.2 per cent if the oscillator frequency is between 45 Hz and 10KHz.

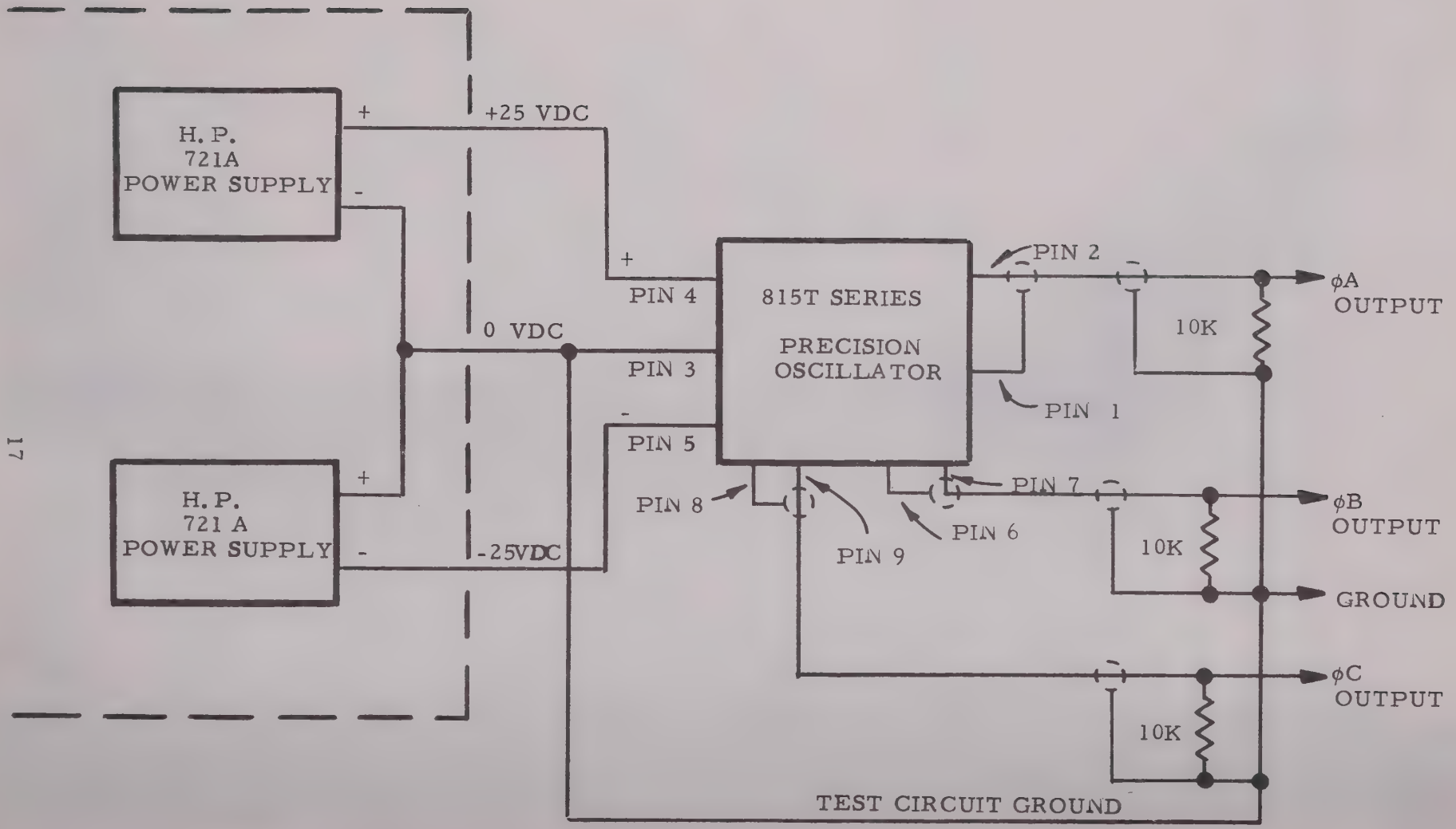


FIGURE 5-1. Test Circuit for 815T Series Oscillators

5.4.2 If the oscillator is a multiphase oscillator, then repeat 5.4.1 for the other phase or phases. The distortion should not exceed that specified in Section 5.4.1

5.5 OUTPUT FREQUENCY AND FREQUENCY STABILITY

Connect the unit as shown in Figure 5-1 and allow the unit to warm-up for one hour in a 25°C environment. The output voltage should be approximately 5 volts rms. Adjust the AMPLITUDE control on the multi-phase oscillator, as required.

5.5.1 Measure the phase "A" output frequency at 25°C with the counter. The frequency of the oscillator should be within ±0.1 percent of that indicated in the manual addendum. Record the frequency for reference in Section 5.5.2 below.

5.5.2 Increase the ambient temperature to 50°C and allow the unit to stabilize for one hour. The output frequency should change less than ±0.5 percent from that indicated at 25°C.

5.6 PHASE ACCURACY

This section of the manual is only applicable to multiphase versions of the 815T Series Oscillator. Connect the oscillator as shown in Figure 5-1 and allow the unit to warm-up for one hour in a 25°C environment.

5.6.1 Rotate the front panel AMPLITUDE control fully clockwise so that the output of phase "A" (Pin 1 and Pin 2 of the printed circuit connector) is greater than 5 volts rms.

5.6.2 Connect a differential phase meter between the phase "A" output and the phase "C" output so that the phase meter reads the phase "C" output referenced to the phase "A" output. The phase meter should indicate +60 ±1 degree for the three phase open delta oscillator; +90 ±1 degree for the two phase oscillator; and +120 ±1 degree for the standard three phase oscillator.

5.6.3 For the standard three phase oscillator, measure the phase shift of the phase "B" output referenced to the phase "A" output. This phase shift must be -120 ±1 degree. If problems are encountered, refer to Section 4.4 through 4.6 of this instruction manual.

5.6.4 Section 5.6.4 applied only to oscillators manufactured after October, 1974 (-4 run). See page ii for further information. Vary the front panel AMPLITUDE potentiometer from 75 percent of full output to full output and check that all phases track within 50 millivolts rms of each other and that the phase angles remain within the ±1 degree tolerance.

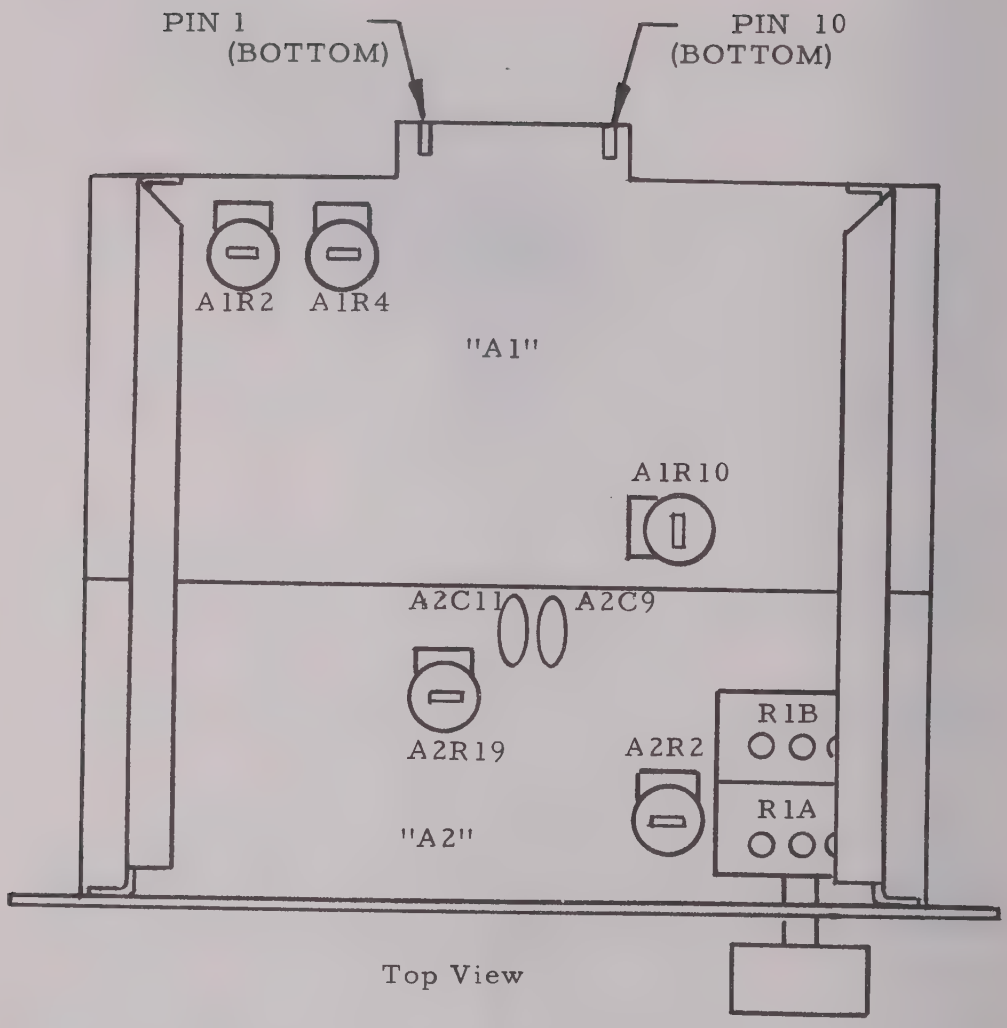


FIGURE 5-2. Locations of Internal Adjustment Potentiometers on Multiphase version of 815T Series Oscillator

MAINTENANCE AND TROUBLESHOOTING

6.1 GENERAL

The California Instruments 815T Series Precision Oscillators are completely solid state and should provide years of trouble-free service. Since the instrument contains no moving parts, periodic maintenance is limited to cleaning in accordance with good commercial shop practices, and a periodic check of frequency accuracy and distortion at six month intervals. If the oscillator is operated in heavy duty applications where severe temperature extremes or mechanical shock are encountered, it is recommended that a more frequent calibration schedule be established.

6.2 TROUBLESHOOTING

6.2.1 Before attempting to repair the oscillator, check that the controls are properly set, that the DC input power is correct and that an excessive load is not connected to the output of the oscillator. Any load impedance less than 5 K ohm per phase should be considered escessive.

6.2.2 Check that the ±15 volt regulator circuits are operating properly and that they have less than 150 millivolts peak-to peak ripple.

6.2.3 Check that the basic Wien bridge oscillator is operating satisfactorily. Detailed information on this circuit is given in Section 3.1 and Section 4.3 in this manual.

6.2.4 Check that the servo feedback loop is operating satisfactorily. Detailed information on this circuitry is given in Section 3.1 of this manual. If the problem appears to be in this area, disconnect transistor A1Q2 and apply -1 to -2 volt DC bias to the gate of A1Q1. This opens the servo feedback loop and allows servicing of this circuitry by conventional signal tracing methods.

6.2.5 If the problem is in the single phase to multiphase converter, the circuit may be checked by conventional signal tracing methods.

CIRCUIT DIAGRAM

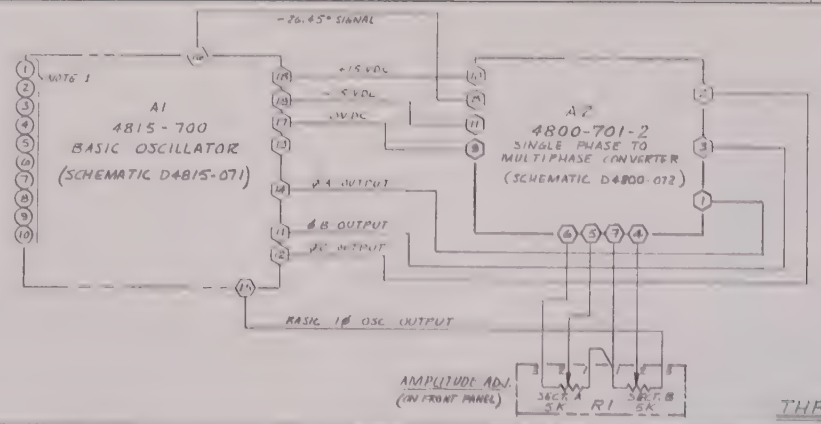
7.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the 815T Series Precision Multiphase Oscillators. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

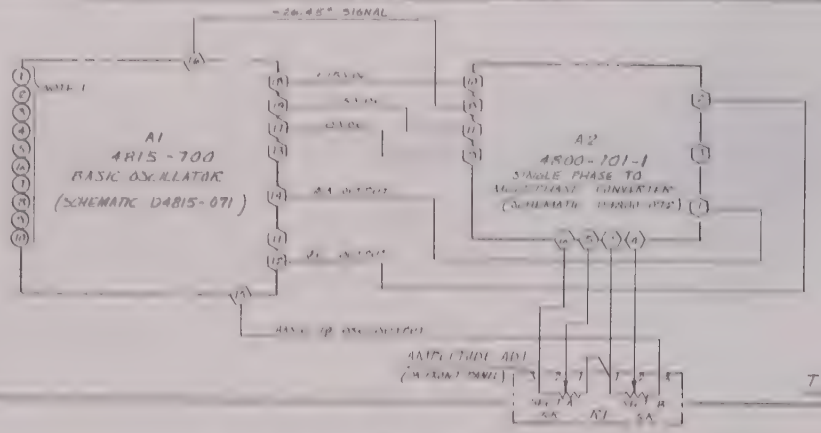
7.2 REFERENCE DESIGNATIONS

Partial reference disignators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference disignator. For example:

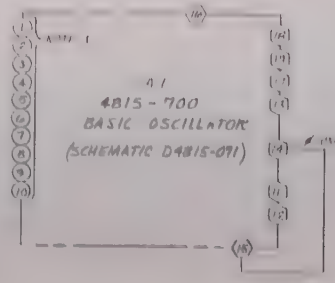
Assembly/Sub-Assembly	Component	Complete Designation
A1	C30	A1C30
None	T1	T1
A2	R1	A2R1



THREE PHASE



TWO PHASE



SINGLE PHASE

2. FOR TOP ASSY, SEE DWG D4815-400.
3. (X) INDICATES TIE POINT EYELET ON P.C. BOARD.
4. (X) INDICATES CONNECTOR CONTACT.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL SPECIFICATION	CODE IDENT	FINISH	REF DES	NOTE
REQUIRED PER ASSY							

REV	AUTH	DESCRIPTION	ZONE	REVISION	DATE	APPD

DIMENSIONS IN INCHES TOLERANCES ON FRACTIONS .XXX ±.010 .XX ±.03 .X ±.1 ANGLES ±1°

BREAK ALL SHARP CORNERS & EDGES MAXIMUM RADIUS .010

SIZE D

TITLE: INNER CONNECTING DIAGRAM 1φ, 2φ & 3φ

MODEL 5157

CONTRACT NO.

CODE IDENT NO. 16067

DWG NO. D4815-070 REV

SCALE NONE SHEET 1 OF 1

RELEASED

CHECKED

DESIGN

DRAFTSMAN

PURCHASING

PROJ ENGR

QUALITY ENGR

APPROVED

DATE 11/6/75

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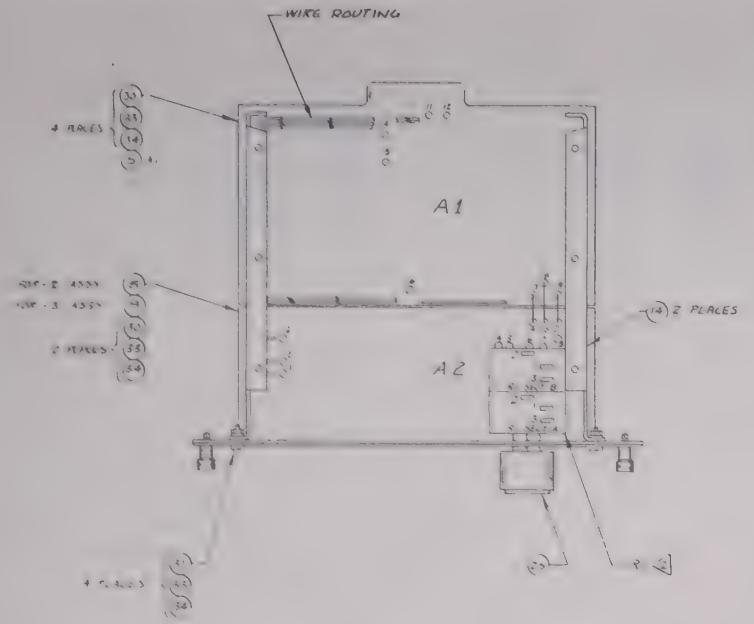
DATE 11-5-75

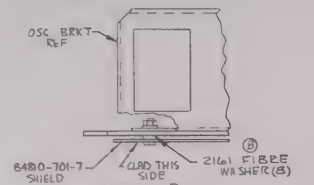
WIRING TABLE 1 (FOR 1Φ UNITS)				
WIRE #	FROM	TO	WIRE	REMARKS
1	A1-14	A1-15	24 AWG	BUSS

WIRING TABLE 2 (FOR 2Φ UNITS)				
WIRE #	FROM	TO	WIRE	REMARKS
1	A1-12	A2-2	24 AWG	BLK
2	A1-15	R1-B-3		BRN
3	A1-14	A2-1		RED
4	R1-16	A2-8		ORN
5	A1-17	A2-9		GRN
6	A1-18	A2-10		BUSS
7	A1-19	A2-11		BUSS
8	A2-6	R1-A-3		YEL
9	A2-5	R1-A-2		GRN
10	A2-7	R1-B-1		BLU
11	A2-4	R1-B-2		VIO
12	R1-A-1	R1-B-1	24 AWG	BUSS

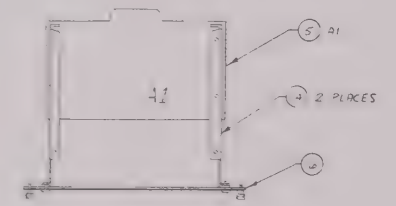
WIRING TABLE 3 (FOR 3Φ UNITS)				
WIRE #	FROM	TO	WIRE	REMARKS
13	A1-11	A2-3	24 AWG	GRAY

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD





VIEW A
SIDE VIEW - FOR UNITS WITH 200Hz OR LESS FREQUENCY.



-1 ASSY - SINGLE PHASE
(USE WIRING TABLE 1)
SCALE 1:2 (FOR HARDWARE CALLOUTS SEE -2 & -3 ASSEMBLIES)

3. INSPECT GROUND CONTINUITY FROM FRONT PANEL CAPTIVE SCREW TO EACH SIDE RAIL, AND ON 800Hz OR LOWER FREQUENCY UNITS, CHECK TO GROUND SHIELD. -2 ASSY - 2 PHASE (USE WIRING TABLE 2) -3 ASSY - 3 PHASE (USE WIRING TABLE 2 & 3)

4 INSTALL NUT ON POT. SIDE (BEHIND F/P) PRIOR TO INSTALLATION.

1 FOR INNER CONNECTION DIAGRAM, SEE DWG D4815-070.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
-3 -2 -1 REQD PER ASSY							
1		3	PL 4815-400-3	PARTS LIST	SHEET 3		
	1	2	PL 4815-400-2	PARTS LIST	SHEET 3		
		1	PL 4815-400-1	PARTS LIST	SHEET 3		

DRAWN: BRIAN A. SHARP 7/10/85
CHECKED: CONNERS & EDDES MFG. CO. 8/15/85
ENGINEER: D
MATERIAL: SPEC
FINISH:
TOLERANCES: FRACT ±1/64, DEC .XX ±.02, .XXX ±.010, ANGLES ±1°
BREAK ALL SHARP EDGES
DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±1/64, DECIMALS .XX ±.02, .XXX ±.010, ANGLES ±1°. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5-1973.
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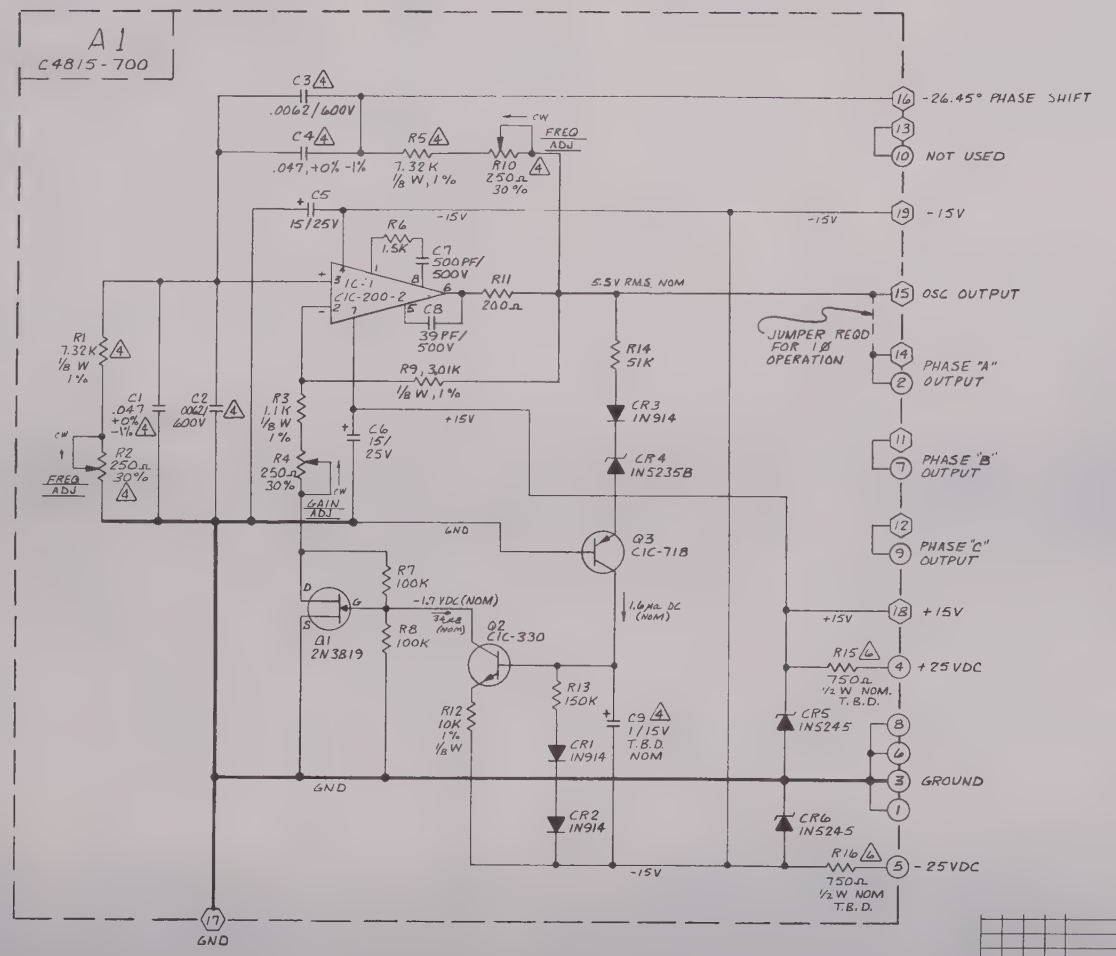
TITLE: SERIES 815T OSCILLATOR, -2 & -3 ASSY
MODEL: P 5
RELEASE:
DRAWN: J
ENGINEER:
DATE: 7/10/85
CONN. DWG. NO. 16067
D4815-400
REV C
SHEET 2 OF 3
CALIFORNIA MICROWAVE, INC. SAN DIEGO, CALIFORNIA

D4815-400C



3 (X) INDICATES CONNECTOR CONTACTS.
(X) INDICATES EYELET TIE POINT ON P.C. BOARD.

2. FOR P.C. BOARD ASSY, SEE DWG C4815-700. FOR 2Ø & 3Ø INTERCONNECTION, SEE DWG D4815-070. FOR FINAL ASSY, SEE DWG D4815-400.

1. RESISTORS ARE ¼W, 5%. VALUE IN OHMS.

NOTES. (UNLESS OTHERWISE SPECIFIED)

6. FOR 1Ø NOM. VALUE IS AS SHOWN. FOR 2Ø & 3Ø NOM. VALUE IS 220Ω, 1W.

5. CAPACITANCE IN MICROFARADS.

4. COMPONENT VALUES ARE SHOWN FOR 400Hz OPERATION ONLY. FOR OPERATIONS AT OTHER FREQUENCIES SEE APPLICABLE PARTS LIST: " FREQUENCY DETERMINING PARTS LIST ".

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	DL	C1 & C4 were ± 1.5%				

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X = 30
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D

TITLE: SCHEMATIC DIAGRAM, BASIC OSCILLATOR

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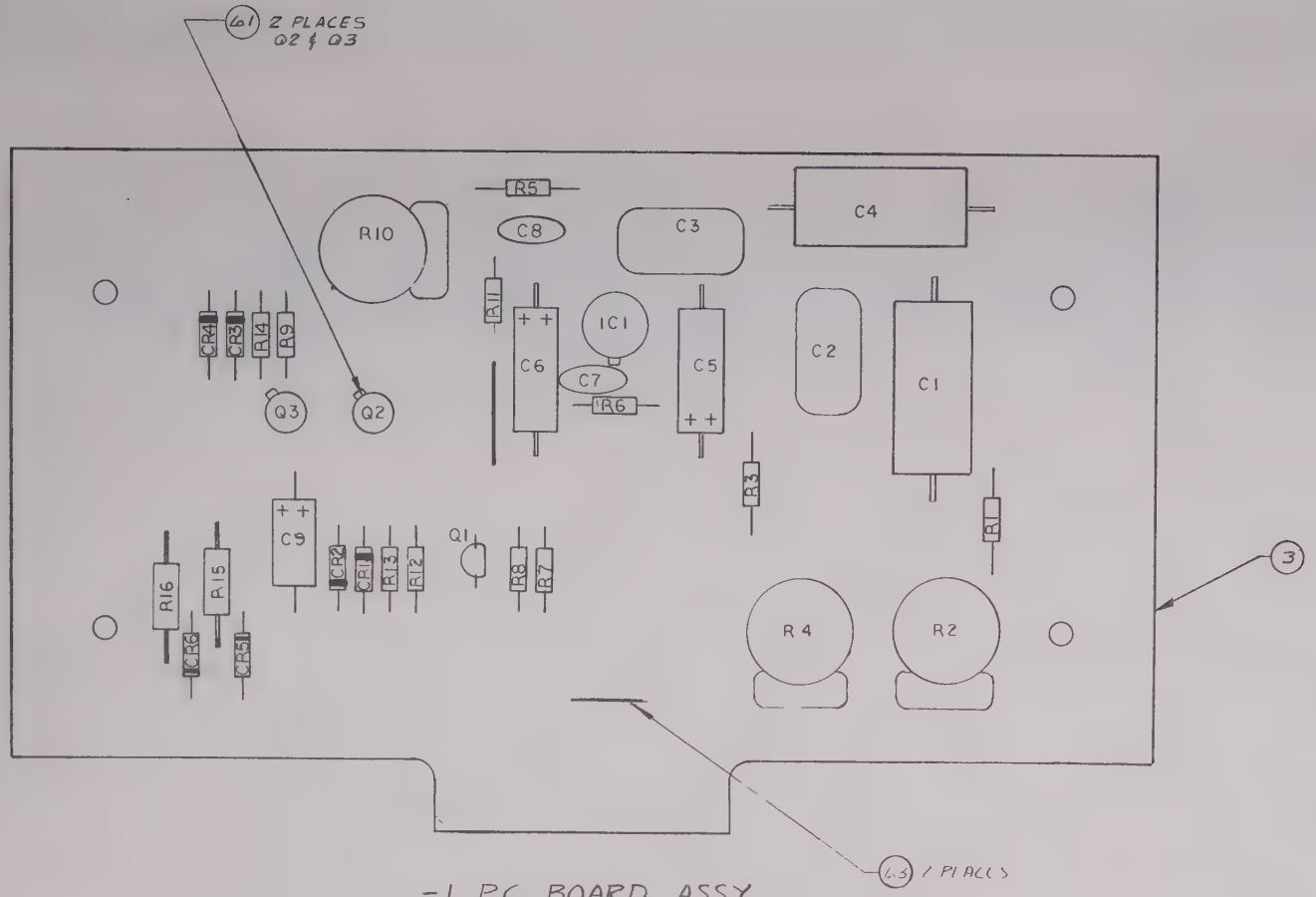
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

MODEL 815T
CONTRACT NO.
CODE IDENT 16067
RELEASE
CHECKER
DESIGN
DRFTSMN MARTIN M
PURCHASING
PROJ ENGR
CHF ENGR
DWG NO. D4815-071
REV A
SCALE NONE
SHEET 1 OF 1

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

D4815-071 A



-1 P.C. BOARD ASSY
VIEW COMPONENT SIDE

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
		P/L 4815-400	PARTS LIST	SEE SHEETS 4 THRU —				

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

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TITLE: P.C. BOARD ASSY, BASIC OSC A1

MODEL 815T

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	4815-400		

RELEASE			
CHECKER	Wiener	6/11/70	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	MARTIN	5-29-70	CHF ENGR

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA
CONTRACT NO.
CODE IDENT 16067
DWG NO. C4815-700 REV A
SCALE 2X SHEET 2 OF —

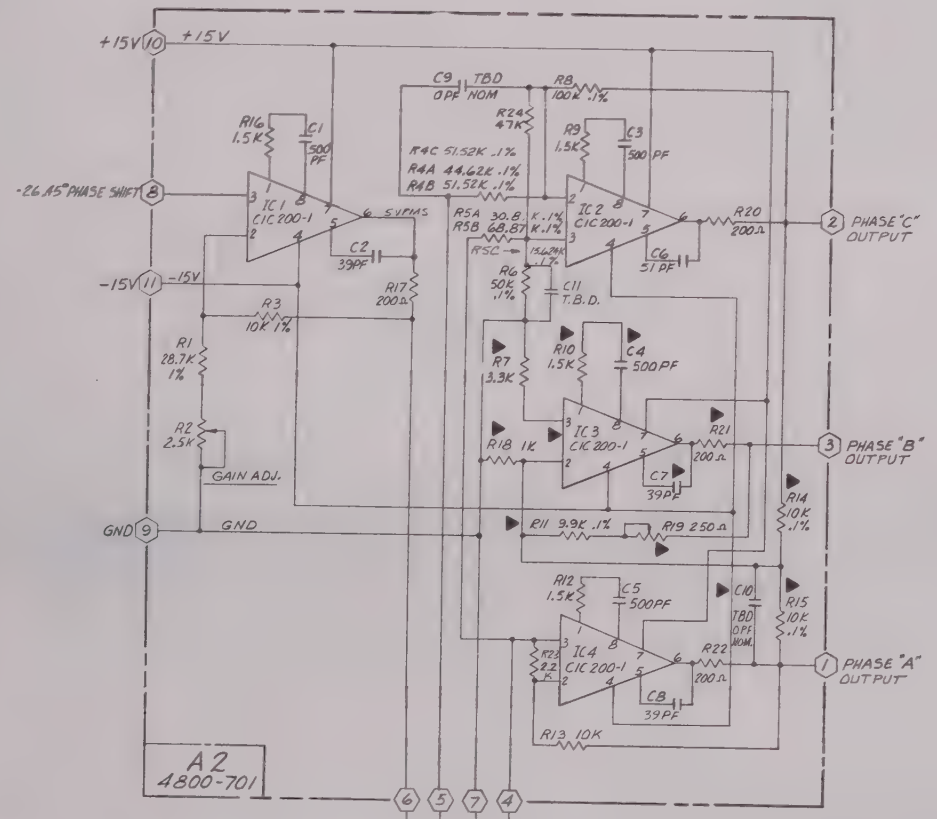
1. FOR SCHEMATIC DIAGRAM, SEE DWG D4815-071.

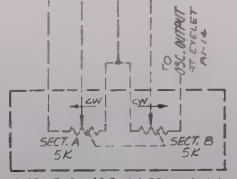
NOTES: (UNLESS OTHERWISE SPECIFIED)

C4815-700 A

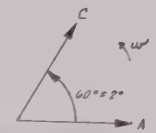
CALICO F-102

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE / APRVD
A	DC.	(22 ARS IK).			
B	E.O.	INC E.O 362 & 368			
C	E.O.	INC E.O. 401			
D	E.O.	INC. E.O 422			
E	DR	DELETED REF DES OF AR-NUT48 BUT			

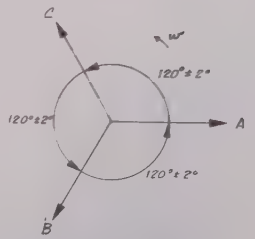




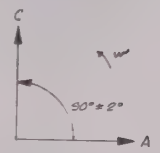
AMPLITUDE ADJ. ON FRONT PANEL (SHOWN FOR REF ONLY)



VECTOR DIAGRAM FOR THREE PHASE OPEN DELTA VERSION OF OSCILLATOR



VECTOR DIAGRAM FOR THREE PHASE VERSION OF OSCILLATOR



VECTOR DIAGRAM FOR TWO PHASE VERSION OF OSCILLATOR

8. FOR INNER CONNECTING DIAGRAM SEE DWG.# D4800-070 (FOR 20/20KHz) AND #D4800-074 (FOR 45/75Hz & 300/500Hz).
7. (X) INDICATES TIE POINT (EYELET) ON P.C. BOARD
6. ALL REF DES ENDING IN 'C' ARE FOR 3Φ OPEN DELTA OPERATION.
5. ALL REF DES. ENDING IN 'B' ARE FOR 3 Φ OPERATION.
4. ALL REF. DES. ENDING IN "A" ARE FOR 2 Φ OPERATION.
3. ▶ NOT USED FOR TWO PHASE OSCILLATOR OR FOR 3 Φ OPEN DELTA OSCILLATOR.
2. FOR P.C. BOARD ASSY SEE DWG#4800-701
1. RESISTORS ARE 1/4 W 5%.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES: XXX ± .010, XX ± .03, X° ± 30'. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓. DWG SIZE D.

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DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

TITLE: SCHEMATIC DIAGRAM, SINGLE PHASE TO MULTIPHASE CONVERTER

MODEL: 800T TWO & THREE PHASE

RELEASE			
CHECKER		PURCHASING	
DESIGN		PROJ ENGR	
DRFTSMN		CHF ENGR	

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. | CODE IDENT 16067

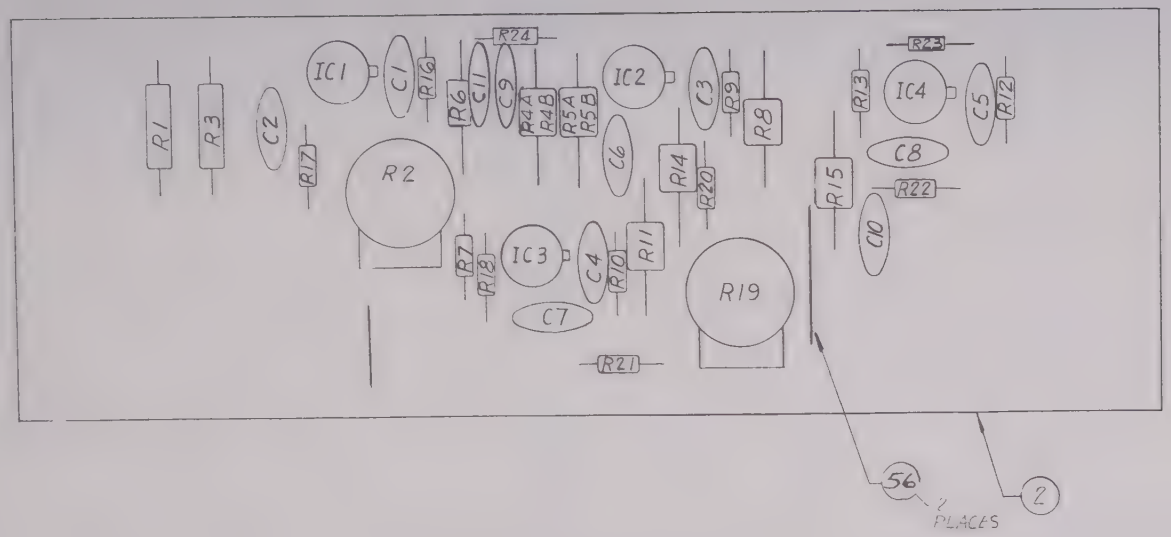
DWG NO. D4800-072 | REV E

SCALE — | SHEET 1 OF 1

CALCO 7-68

D4800-072 E

A2



-1 P.C. BOARD ASSY
VIEW COMPONENT SIDE

A2

D1800-701 PARTS LIST SHEET 4 & 5

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
-1								

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X = .06
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √
DWG SIZE C

TITLE SINGLE PHASE TO MULTIPHASE CONVERTER P.C. BOARD ASSY

MODEL 800T
RELEASE
CHECKER PURCHASING
DESIGN PROJ. ENGR.
DRFTSMN CHF ENGR.

DASH NO. PROD. NEXT ASSEMBLY EFF. ON A/TH

DAI FORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

CONTRACT NO. CODE IDENT 16067

DWG NO. C4800-701 REV. E

SCALE 2:1 SHEET 2 OF 5

1. FOR SCHEMATIC DIAGRAM SEE DWG. NO. D4800-012

NOTES (UNLESS OTHERWISE SPECIFIED)

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C4800-701 E

A2

REPLACEMENT PARTS

8.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alphanumerical order of their reference designators. Description, manufacturer's part number, manufacturer's code ident numbers (see Appendix A for list of manufacturers), and California Instruments' stock numbers are indicated.

8.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument

b) California Instruments part number of the sub-assembly where component is located

c) Component reference designator

d) Component description

e) Component manufacturer number and code ident

f) California Instruments stock number

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, a division of Aiken Industries, San Diego, California, 92111.

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

EF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	D4815-400-1	815T OSC, SINGLE PHASE	16067		1
	D4815-400-2	815T OSC, 2 PHASE	16067		2
	D4815-400-3	815T OSC, 3 PHASE	16067		3
					4
1	C4815-700-1	P.C. BOARD ASSY, BASIC	16067		5
	APPLICABLE FREQUENCY DETERMINING PARTS LIST				6
					7
2	4800-701-1	P.C. BOARD ASSY, 2ϕ	16067		8
2	4800-701-2	P.C. BOARD ASSY, 3ϕ	16067		9
					10
1	534 5K/5K BUSHING MOUNT	POT, DUAL GANG, 5K-5K	02111	5-70170	11
					12
					13
	4810-201-7	FRAME, PLUG-IN	16067	1-60001	14
					15
	4810-200-5	FRONT PANEL, 1ϕ	16067	1-10189	16
	4810-200-6	FRONT PANEL, 2ϕ or 3ϕ	16067	1-10190	17
					18
	4810-202-7	NAME PLATE	16067	1-60000	19
	SILKSCREEN - FREQUENCY, ACCURACY AND PHASE -				20
	USING FILM POSITIVE CALLED OUT ON ERA				21
					22
					23
					24
	PS-95-2-Blk	KNOB	21604	2-40295	25
					26
					27
	#00 x 1/8 Lg.	DRIVE SCREW, TYPE U	45722	2-10024	28
					29
	4-40UNC x 1/4 Lg.	SCREW, PAN HEAD			30
	4-40UNC x 3/8 Lg.	SCREW, PAN HEAD			31
					32
	#4	INT STAR LKWASH			33
	4-40UNC x 1/4 Hex	MACHINE NUT			34
					35
					36

DEL	815T	CALICO P/N 4815-400	B	ASSY R.O.
TLE	815T SERIES ASSEMBLY		SHT 3 OF 3	

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	4815-700	P. C. BOARD ASSEMBLY	16067		1
					2
	4815-700-7	P. C. BOARD	16067	1-60109	3
	SEE SHEET 3	EYELET			4
					5
C1	*				6
C2	*				7
C3	*				8
C4	*				9
C5	TE 1205	CAPACITOR 15µf/25V	56289	6-10731	10
C6	TE 1205	CAPACITOR 15µf/25V	56289	6-10731	11
C7	DD 501	CAPACITOR 500pf/1000V	71590	6-10729	12
C8	CM05E390J03	CAPACITOR 39pf/500V	81349	6-10013	13
C9	*				14
					15
					16
					17
					18
					19
CR1	1N914	DIODE	81349	3-10118	20
CR2	1N914	DIODE	81349	3-10118	21
CR3	1N914	DIODE	81349	3-10118	22
CR4	1N5235B	DIODE, ZENER	04713	3-10196	23
CR5	1N5245	DIODE, ZENER	04713	3-10067	24
CR6	1N5245	DIODE, ZENER	04713	3-10067	25
					26
					27
					28
					29
IC1	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	30
					31
					32
					33
					34
					35
	* SEE FREQUENCY	DETERMINING PARTS LIST			36

DEL	815T	CALICO P/N 4815-700	A	ASSY R.O.
LE	P.C. BOARD, BASIC OSCILLATOR		SHT 4 OF 7	A1

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1Q1	2N3819	FIELD EFFECT TRANSISTOR	01295	3-30197	37
A1Q2	CIC-330	TRANSISTOR	16067	3-30008	38
A1Q3	CIC-718	TRANSISTOR	16067	3-30041	39
					40
					41
					42
A1R1	*				43
A1R2	*				44
A1R3	RN60C1101F	RESISTOR 1.1K 1/8W 1%	81349	5-60423	45
A1R4	U-201R251B	POTENTIOMETER 250Ω	71450	5-70012	46
A1R5	*				47
A1R6	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	48
A1R7	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	49
A1R8	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	50
A1R9	RN60C3011F	RESISTOR 3.01K 1/8W 1%	81349	5-60233	51
A1R10	*				52
A1R11	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	53
A1R12	RN60D1002F	RESISTOR 10K 1/8W 1%	81349	5-60079	54
A1R13	RC07GF154J	RESISTOR 150K 1/4W 5%	81349	5-10104	55
A1R14	RC07GF513J	RESISTOR 51K 1/4W 5%	81349	5-10093	56
A1R15	RC20GF751J ◁1	RESISTOR 750Ω 1/2W 5%	81349	5-20031	57
A1R16	RC20GF751J ◁1	RESISTOR 750Ω 1/2W 5%	81349	5-20031	58
					59
					60
	RCT018110-1A	TRANSIPAD, TO-18	19080	2-40297	61
					62
	20 AWG	BUSS WIRE			63
					64
					65
					66
					67
					68
	◁1 FOR 2Ø and 3Ø	UNITS VALUE IS 220Ω, 1W RC32GF221J, 5-30025			69
					70
	* SEE FREQUENCY DETERMINING PARTS LIST				71
					72

MODEL 815T | CALICO P/N 4815-700 C | ASSY R.O

TITLE P. C. BOARD, BASIC OSCILLATOR | SHT 5 OF | A1

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2	4800-701-0	P. C. BOARD ASSY--Basic	16067		1
	4800-701-1	P. C. BOARD ASSY--Two ϕ	16067		2
	4800-701-2	P. C. BOARD ASSY--Three ϕ	16067		3
	-7	P. C. BOARD	16067	1-55067	4
	SEE SHEET 3	EYELET			5
					6
					7
A2C1	DD 501	CAPACITOR 500 pf	71590	6-10725	8
A2C2	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	9
A2C3	DD501	CAPACITOR 500 pf	71590	6-10725	10
A2C4	DD501	CAPACITOR 500 pf	71590	6-10725	11
A2C5	DD501	CAPACITOR 500 pf	71590	6-10725	12
A2C6	CM05E510J03	CAPACITOR 51 pf	04062	6-10016	13
A2C7	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	14
A2C8	CM05E390J03	CAPACITOR 39 pf	04062	6-10013	15
A2C9	t. b. d.	CAPACITOR			16
A2C10	t. b. d.	CAPACITOR			17
A2C11	CM05	CAPACITOR, T. B. D.	81349		18
					19
					20
A2IC1	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	21
A2IC2	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	22
A2IC3	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	23
A2IC4	CIC 200-1	INTEGRATED CIRCUIT	16067	3-30134	24
					25
					26
					27
A2R1	RN60D2872F	RESISTOR 28.7K 1%	JEDEC	5-60107	28
A2R2	U-201R252	VAR. RESISTOR 2.5K	11237	5-70023	29
A2R3	RN60D1002F	RESISTOR 10K 1%	JEDEC	5-60079	30
A2R4A	S51-9-44.62K-.1%	RESISTOR 44.62K .1%	17745	5-80134	31
A2R4B	S51-9-51.52K-.1%	RESISTOR 51.52K .1%	17745	5-80136	32
A2R5A	S51-9-30.8K-.1%	RESISTOR 30.8K .1%	17745	5-80133	33
A2R5B	S51-9-68.87K-.1%	RESISTOR 68.87K .1%	17745	5-80137	34
A2R6	S51-9-50.0K-.1%	RESISTOR 50K .1%	17745	5-80135	35
A2R7	RC07GF332J	RESISTOR 3.3K 1/4W 5%	JEDEC	5-10064	36

MODEL 800T | CALICO P N 4800-701 | E | ASSY R.O. A2

TITLE SINGLE ϕ TO MULTI ϕ CONVERTER BOARD ASSEMBLY | SHT 4 OF 5

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2R8	S51-9-100.0K-.1%	RESISTOR 100K .1%	17745	5-80138	37
A2R9	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	38
A2R10	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	39
A2R11	S51-9-9.9K-.1%	RESISTOR 9.9K .1%	17745	5-80131	40
A2R12	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	41
A2R13	RC07GF103J	RESISTOR 10K 1/4W 5%	JEDEC	5-10076	42
A2R14	S51-9-10.0K-.1%	RESISTOR 10K .1%	17745	5-80132	43
A2R15	S51-9-10.0K-.1%	RESISTOR 10K .1%	17745	5-80132	44
A2R16	RC07GF152J	RESISTOR 1.5K 1/4W 5%	JEDEC	5-10057	45
A2R17	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	46
A2R18	RC07GF102J	RESISTOR 1K 1/4W 5%	JEDEC	5-10053	47
A2R19	U-201R251B	VAR. RESISTOR 250Ω	11237	5-70012	48
A2R20	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	49
A2R21	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	50
A2R22	RC07GF201J	RESISTOR 200Ω 1/4W 5%	JEDEC	5-10036	51
A2R23	RC07GF222J	RESISTOR 2.2K 1/4W 5%	JEDEC	5-10060	52
A2R24	RC07GF473J	RESISTOR 47K 1/4W 5%	JEDEC	5-10092	53
					54
					55
	#24 AWG	BUSS WIRE			56
					57

MODEL 800T | CALICO P'N 4800-701 | D | ASSY R.O. A2

TITLE SINGLE ϕ TO MULTI ϕ CONVERTER BOARD ASSEMBLY | SHT 5 OF 5

FREQUENCY DETERMINING PARTS LIST

The following addendum parts list defines value and manufacturer's part number of components not listed in the preceeding parts list.

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, PA
0000B	Tech. Prod. Sales	Sorrento Valley, CA
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, IL
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, CA
0000G	Use Code #30983	
0000H	Mial of Italy c/o Q.C. Components	Los Angeles, CA
0000I	Use Code #50522	
0000J	Use Code #34333	
0000K	Elma	Schweiz, Germany
0000L	Use Code #32293	
0000M	Use Code #16950	
0000N	Use Code #15912	
0000R	American Handle	Philadelphia, PA
0000S	OPCDA	Edison, NJ
0000T	Use Code #31743	
0000U	Use Code #32293	
0000V	Falmat	Los Angeles, CA
0000W	Milton Ross Co.	Southampton, PA
0000X	Use Code #52072	
0000Y	Use Code #29990	
00141	Pic Design Corp.	E. Rockaway, NY
00194	Walsco Electronics Corporation	Los Angeles, CA
00544	Metal-Cal Div., Avery Prod. Corp.	Inglewood, CA
00656	Aerovox Corporation	New Bedford, MA
00779	AMP, Inc.	Harrisburg, PA
00853	Sangamo Electric Company	Pickens, SC
00866	Goe Eng. Co., Inc.	City of Industry, CA
01121	Allen-Bradley Company	Milwaukee, WI
01179	Ajax Magnethermic Corp.	NE Warren, OH
01255	Litton Industries, Inc.	Beverly Hills, CA
01281	T R W Semiconductors, Inc.	Lawndale, CA
01295	Texas Instruments, Inc.	Dallas, TX
02111	Spectrol Electronics	City of Industry, CA
02114	Ferroxcube Corp.	Saugerties, NY
02335	Fairchild Controls Corp.	Hicksville, LI, NY
02660	Amphenol Corporation	Broadview, IL
02799	Use Code #72136	
03507	General Electric Company	Syracuse, NY
03508	General Electric Company	Syracuse, NY
03516	General Electric Company	Somersworth, NH
03797	Eldema Corporation	Compton, CA
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, NJ
03911	Clairex Corporation	New York, NY
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, CT
04062	Use Code #72136	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, AZ
04963	3-M	St. Paul, MN
05236	Jonathan Mfg. Co.	Fullerton, CA
05276	Pomona Electronics Co., Inc.	Pomona, CA
05347	Ultronixs	Grand Junction, CO
05397	Kemet, Union Carbide Corp.	Cleveland, OH
05820	Wakefield Engineering, Inc.	Wakefield, MA
06046	Dixson Meter	Grand Junction, CO
06184	Conelco Components	San Bernadino, CA
06223	Kooltronic Fan Company	Princeton, NJ
06229	Electrt, Incorporated	Mt. Vernon, NY
06383	Panduit Corp.	Tinley Park, IL
06514	Stantron, Wyco Metal Products	N. Hollywood, CA
06540	Amathom Elect. Hardward	New Rochelle, NY
06682	Magnetic Shield Div.	Chicago, IL
06776	Robinson, Nugent, Inc.	New Albany, IN
06915	Richco Plastics, Co.	Chicago, IL
07088	Kelvin Electric Company	Van Nuys, CA
07115	Use Code #14674	
07256	Silicon Transistor Corp.	Garden City, NY
07263	Fairchild Camera and Instr. Corp.	Mt. View, CA
07387	Birtcher Corporation	Los Angeles, CA
07556	Unitrack Calabro Plastics	Upper Darby, PA
07633	Epoxy Prod. Co. Div. of Allied Prod. Corp.	New Haven, CT
07713	Sperry Rand Corporation	Norwalk, CT
07716	I R C Incorporated	Burrington, IA
07910	Continental Devices	Hawthorne, CA
08065	Accurate Rubber and Plastics Co.	San Diego, CA
08261	Spectra Strip	Garden Grove, CA
08289	Blinn-Dibert Co., Inc.	Pomona, CA
08594	Eimac Div. of Varian Associates	Salt Lake, UT
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, NJ
09026	Babcock Electronics Corp.	Costa Mesa, CA
09145	Atohm, Technical Industries, Inc.	Burbank, CA
09353	C and K Components, Inc.	Newton, MA
11432	Diamond Metal Sales	Gardena, CA
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, CA
12020	Ovenaire, Incorporated	Charlottesville, VA
12143	Bendix Corporation	Santa Ana, CA
12405	Hysol Corporation	El Monte, CA
12406	Elpac, Incorporated	Fullerton, CA
12463	Omtronics Mfg., Incorporated	Omaha, NE
12673	Wesco Electrical Co.	Greenfield, MA
12697	Clarostat Mfg. Co., Incorporated	Dover, NH
13103	Thermalloy Company	Dallas, TX
13454	Texas Crystals	River Grove, IL
13571	Electronic Research	Overland Park, KS
13919	Burr-Brown Research Corp.	Tucson, AS
14099	Semtech Corporation	Newbury Park, CA
14193	Cal-R Inc.	Santa Monica, CA
14655	Cornell-Dubilier Elect. Corp.	Newark, NJ
14674	Corning Glass Works	Corning, NY
14726	Hollingsworth Co.	Phoenixville, PA
14752	Electro Cube, Incorporated	San Gabriel, CA
14907	Cramer Div. of Conrac	Old Saybrook, CT
15112	Electra Scientific Corporation	Fullerton, CA
15636	Elec-trol	Northridge, CA
15801	Fenwall Electronics	Framingham, MA
15818	Amelco, Teledyne, Incorporated	Mt. View, CA
15909	Use Code #17870	
15912	Ansley	Los Angeles, CA
16067	California Instruments Company	San Diego, CA
16758	Delco Radio Div., General Motors	Kokomo, IN
16795	Bristol Electronics Inc.	Bedford, MA
16902	Simpson Instruments, Inc.	Escondido, CA
16950	Precision Dynamics Corp.	Burbank, CA
17745	Angstrohm Precision, Inc.	Van Nuys, CA
17838	Mektron, California General, Inc.	Chula Vista, CA
17870	Daven Div., Thomas A. Edison	Manchester, NH
18076	Umpco	City of Industry, CA
18121	Wilshire Foam Products, Inc.	Gardena, CA
18178	Vactec Inc.	Maryland Heights, MO
18324	Signatics	Sunnyvale, CA
18612	Vishay Instruments Inc.	Malvern, PA
18677	Scambe Mfg. Co.	Monterey Park, CA
18702	Ducommun Metals and Supply Co.	Los Angeles, CA
18722	R C A	Mountaintop, PA
19080	The Robinson Company	Hawthorne, CA
19781	Potter Company	Sun Valley, CA
20857	South Bay Cable Corp.	Gardena, CA
21270	Behr-Manning	Watervliet, NY
21604	Buckeye Stamping Company	Columbus, OH
22045	Jordan Elect.	Van Nuys, CA
22599	Elastic Stop Nut Corporation	Van Nuys, CA
23039	Deccofelt Products Company	Glendora, CA
23050	Product Components Corp.	Hastings-on-Hudson, NY
23095	Aztec Electronics Inc.	Anaheim, CA
23783	British Radio Electric Ltd.	Washington, DC
23936	Pamotor, Incorporated	San Francisco, CA
24011	E C C	Burlington, MA
24655	General Radio	Concord, MA
24796	Parelco Inc.	Paramount, CA
24931	Specialty Connector Co., Inc.	Indianapolis, IN
25403	Amperex (Diodes)	Slaterville, RI
25684	Victoreen Instrument Co., Inc.	Oak Lawn, IL
25706	Daburn Electronics and Cable Corp.	New York, NY
26528	Lamcor, Incorporated	Anaheim, CA
26533	Use Code #98376	
27014	National Semi-Conductor Corp.	Santa Clara, CA
27191	Cutler-Hammer, Inc.	Milwaukee, WI
27264	Molex	Downers Grove, IL
27556	IMB Electronic Products	Santa Fe Springs, CA
27683	Varo, Incorporated	St. Garland, TX
28480	Hewlett-Packard Co.	Palo Alto, CA
*28520	Heyman Mfg. Company (Heyco)	Kenilworth, NJ
30086	I-T-E Circuit Breaker Co.	Philadelphia, PA
30817	Instrument Specialties Co.	Little Falls, NJ
30897	Dorann Co.	Sylmar, CA
30983	Electra/Midland (Mepco/Electra)	San Diego, CA
31743	Elpower	Santa Ana, CA
31951	Triridge Inc.	Pittsburgh, PA
32293	Intersil	Cupertino, CA
34333	Silicon General	Westminister, CA
35929	Constanta	Quebec, Canada
42190	Muter Company	Chicago, IL
44655	Ohmite Manufacturing Company	Skokie, IL
45722	Parker-Kalon	Clifton, NJ
46384	Penn. Eng. and Mfg. Corp.	Doylestown, PA
49956	Raytheon Co.	Lexington, MA
50522	Monsanto, Electronic Special Products	Cupertino, CA
51705	ICO/Rally	Palo Alto, CA
52072	Circuit Assembly Corp.	Costa Mesa, CA
53209	W. H. Brady Co.	Milwaukee, WI
56289	Sprague Electric Company	North Adams, MA
57771	Stimson	Bayport, NY
58474	Superior Electric Company	Bristol, CT
59730	Thomas and Betts Company	Elizabeth, NJ
60741	Triplett Electrical Instrument Co.	Bluffton, OH
63743	Ward Leonard Electric Co.	Mt. Vernon, NY
70318	Allmetal Screw Prod. Co.	Garden City, NY
70903	Belden Manufacturing Co.	Chicago, IL
71002	Birnbach Radio Company, Inc.	New York, NY
71218	Bud Radio	Willoughby, OH
71279	Cambridge Thermionic Corp.	Cambridge, MA
71400	Bussman Mfg. Div., McGraw-Edison Co.	St. Louis, MO
71450	CTS Corporation	Elkhart, IN
71468	ITT Cannon Electric, Inc.	Los Angeles, CA
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, WI
71744	Chicago Miniature Lampworks	Chicago, IL
71785	Cinch Manufacturing Company	Chicago, IL
72136	Elmenco (Electro Motive)	Willimantic, CT
72259	Nytronics, Incorporated	Pelham Manor, NY
72619	Dialight Corporation	Brooklyn, NY
72699	General Instruments	Newark, NJ
72982	Erie Technological Products, Inc.	Erie, PA
73138	Beckman Instruments, Inc.	Fullerton, CA
73445	Amperex (Capacitors)	Long Island, NY
73559	Carling Electric, Inc.	West Hartford, CT
73734	Federal Screw Products, Inc.	Chicago, IL
73899	J F D Electronics Company	Brooklyn, NY
73949	Guardian Electric Mfg. Co.	Chicago, IL
73957	Groov-Pin Corporation	Ridgefield, NJ
74193	Heinemann Electric Company	Trenton, NJ
74276	Signalite, Incorporated	Neptune, NJ
74542	Hoyt Electrical Instrument Works	Penacook, NH
74545	Harvey Hubbel, Inc.	Bridgeport, CT
74970	E. F. Johnson Company	Waseca, MN
75382	Kulka Electric Corporation	Mt. Vernon, NY
75915	Littlefuse, Incorporated	Des Plaines, IL
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, IN
76348	Miller Products Company	New York, NY
76385	Minor Rubber Co.	Bloomfield, NJ
76493	J. W. Miller Company	Los Angeles, CA
76854	Oak Manufacturing Company	Crystal Lake, IL
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, IN
77638	General Instruments	Brooklyn, NY
77969	Rubber Craft Corp. of California	Torrance, CA
78189	Shakeproof Div., Illoms Tool Works	Chicago, IL
78299	Struthers-Dunn. Incorporated	Pitman, NJ
78488	Stackpole Carbon Company	St. Marys, PA
78526	Stanwyck Winding Company, Inc.	Newburgh, NY
78553	Tinnerman Products, Inc.	Cleveland, OH
78947	Ucinite Company	Newtonville, MA
79130	Johns-Manville Products Corp.	Chicago, IL
79727	Continental-Wirt Electronics Corp.	Warminister, PA
79963	Zierick Mfg. Corporation	New Rochelle, NY
80031	Mepco/Electra	Morristown, NJ
80112	G, C, Electronics Company	Los Angeles, CA
80223	United Tracrmer Co.	New York, NY
80294	Bourns, Incorporated	Riverside, CA
80368	Sylvania Electric Products, Inc.	New York, NY
80583	Hammarlund Mfg. Co.	Red Bank, NJ
81073	Grayhill, Incorporated	La Grange, IL
81095	Triad Transformer Corp.	Venice, CA
81312	Winchester Electronics	Oakville, CT
81349	Military Spec., Standardization Division Directorate of Logistic Services DSA	
82104	Standard Grigsby	Aurora, IL
82389	Switchcraft, Incorporated	Chicago, IL
82877	Rotron Manufacturing Co., Inc.	Woodstock, NY
82893	Vector Electronics Inc.	Sylmar, CA
83058	Car Fastener Company	Cambridge, MA
83125	Nytronics Inc. Cap. Division	Darlington, SC
83324	Rosan, Incorporated	Newport Beach, CA
83330	Herman H. Smith, Inc.	Brooklyn, NY
83594	Burroughs Corporation	Plainfield, NJ
83701	Electronic Devices, Incorporated	Yonkers, NY
83827	Resistors Inc.	Chicago, IL
84171	Arco Electronics, Inc.	Great Neck, NY
86684	R C A	Harrison, NJ
86928	Seastrom Mfg. Co.	Glendale, CA
87034	Marco-Oak Industries	Anaheim, CA
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, CA
90201	Mallory Capacitor Company	Indianapolis, IN
91459	Alcon Metal Prod. Inc.	Chicago, IL
91506	Augat	Attlebord, MA
91637	Dale Electronics, Inc.	Columbus, NE
91662	Elco Corporation	Willow Grove, PA
91812	Janco Corporation	Burbank, CA
91833	Keystone Electronics Corp.	New York, NY
91929	Micro Switch Div., Honeywell, Inc.	Freeport, IL
92194	Alpha Wire Corporation	Elizabeth, NJ
92219	Waldom Electronics, Inc.	Chicago, IL
93332	Sylvania Electric Products, Inc.	Woburn, MA
94222	Southco, Incorporated	Lester, PA
95146	Alco Electronics Products	Lawrence, MA
95303	R C A	Cincinnati, OH
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, IL
96682	Genisco, Incorporated	Compton, CA
96733	San Fernando Electric Mfg. Co.	San Fernando, CA
97525	Electronic Engineering Co.	Santa Ana, CA
97918	Linemaster Switch Corp.	Woodstock, CT
97954	U.S. Components, Incorporated	Bronx, NY
98159	Rubber Teck, Incorporated	Gardena, CA
98278	Microdot, Incorporated (Lerco)	S. Pasadena, CA
98291	Sealectro Corp.	Mamaroneck, NY
98376	Zero Mfg. Co. (West)	Burbank, CA
98978	IERC	Burbank, CA
99028	Globe	Gardena, CA
99378	Atlee Corp.	Woburn, MA
99392	STM Corporation	Oakland, CA
99515	Marshall Industries	Monrovia, CA
99517	Vacco Industries	El Monte, CA
99742	Permacel Div., Johnson and Johnson	New Brunswick, NJ
99743	I M C	Maywood, CA
99800	Delevan Electronics Corporation	Aurora, NY
*29990	American Technical Ceramics	Huntington Station, NY

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS COMPANY a division of AIKEN INDUSTRIES INC. warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS COMPANY will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS COMPANY will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS COMPANY or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALIFORNIA INSTRUMENTS COMPANY will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.